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Bees do not learn to be cooperative - it is in their genes



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The cooperative behavior of bees, resembling a singular “superorganism,” is something uniquely remarkable in the world of nature.

It is not uncommon for thousands of worker bees to function collectively to protect the colony, feed it, and look after the offspring. This intricate social conduct unifies their individual actions into a concerted effort.

But how is this complex behavior encoded and inherited among generations of [honey bees](#)? The answer lies in a special gene, as unveiled by a team of scientists.

The research was led by experts at Heinrich Heine University Düsseldorf ([HHU](#)), along with colleagues from Frankfurt/Main, Oxford, and Würzburg. The study has uncovered the genetic underpinnings of honey bee cooperation.



have made this breakthrough discovery. The research was focused on a gene called “doublesex” or “dsx.”

“The behavioral repertoire of the individual bees and their function in the colony are not learned, but rather inherited. Until now, it was not known how such complex behaviors were genetically encoded,” said Dr. Beye.

The key discovery is that the dsx gene influences worker bee-specific behavior, noted study first author Dr. Vivien Sommer.

“The gene programs whether a worker bee takes up a task in the colony and for how long. This includes collective tasks such as caring for the larvae or foraging for food and social exchanges on food sources, for example,” said Dr. Sommer.

Gene editing in bees

The team used the CRISPR/Cas9 gene-editing technique to modify the dsx gene in select bees, attaching a QR code to the manipulated bees.

Cameras inside the hive monitored the bees’ behavior, and with the assistance of artificial intelligence, video sequences were analyzed to determine individual behavioral patterns.

“Our central question was whether and how the inherited behavioral patterns changed as a result of the gene modification. Such changes must be reflected in the nervous system of the worker bees where the specific behaviour is controlled,” said Dr. Sommer.

Adding a twist, the researchers introduced a green fluorescent protein (GFP) into the dsx sequence to visualize the neuronal circuits.

They found that the dsx gene plays a crucial role in creating specific neural pathways in the bee’s brain, according to doctoral researcher Jana Seiler, who is also a co-author of the study.

New chapter in bee behavior

“Our findings indicate a fundamental genetic program that determines the neuronal circuitry and behavior of worker bees,” said Dr. Wolfgang



whole bee colony and understand how the gene influences the “superorganism.”

“We hope to find the link between individual programming and the coordinated behaviour of many individuals,” said Alina Sturm, a doctoral researcher at HHU.

Revealing the genetic secret behind the collective behavior of honey bees is more than just a scientific breakthrough. It’s a tribute to the remarkable complexity of nature and its infinite capacity for surprise.

Broader implications of bee behavior

The discovery of a gene that influences honey bee behavior has implications beyond the study of bees.

Understanding how a [single gene](#) can shape complex social dynamics could inspire innovations in fields such as robotics and artificial intelligence.

For example, roboticists often look to nature for insights into building more efficient, cooperative systems. The hive’s “superorganism” structure could serve as a model for developing autonomous swarm robots designed to work together toward a shared goal.

Additionally, the study of bee cooperation offers valuable insights for ecology and conservation.

Honey bees play a critical role in pollination. Identifying the genetic foundations of their social behavior could lead to better strategies for supporting bee populations amid environmental threats.

By shedding light on the inner workings of the hive, this research adds a new dimension to preserving biodiversity and maintaining the stability of ecosystems that rely heavily on [pollinators](#).

The study is published in the journal [Science Advances](#).

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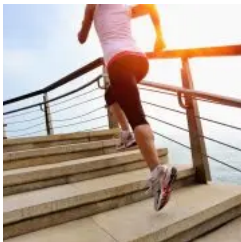
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